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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/762,764	01/22/2004	Ming Xi	AMAT/4714.C1/CPI/WCVD/PJS	3117

7590 10/07/2004  
APPLIED MATERIALS, INC.  
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EXAMINER

ZARNEKE, DAVID A

ART UNIT	PAPER NUMBER
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2829

DATE MAILED: 10/07/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/762,764

Applicant(s)

XI ET AL.

Examiner

David A. Zarneke

Art Unit

2829

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-14 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-14 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 22 January 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_.

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

*(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.*

Claims 1, 2, and 4 are rejected under 35 U.S.C. 102(e) as being anticipated by Kang et al., U.S. Patent 6,139,700.

Kang teaches a method of forming a nucleation layer and a bulk deposition layer on a substrate disposed in a processing chamber, said method comprising:

- a) forming a refractory metal nucleation layer, WN, by serially exposing said substrate to first and second reactive gases (claim 16); and
- b) forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said first and second reactive gases (6, 13+).

Regarding claim 2, Kang teaches the bulk deposition layer is deposited using chemical vapor deposition ((6, 13+).

With respect to claim 4, Kang teaches the forming of the nucleation layer further includes introducing a purge gas into the processing chamber after exposing said substrate to the first reactive gas and before exposing said substrate to said

second reactive gas (claim 7).

***Claim Rejections - 35 USC § 102***

Claims 10-13 are rejected under 35 U.S.C. 102(e) as being anticipated by Kang et al., U.S. Patent 6,139,700.

Kang teaches a method of forming a nucleation layer and a bulk deposition layer on a substrate, said method comprising:

serially exposing said substrate to first and second reactive gases, wherein said second reactive gas comprises a refractory metal selected from the group consisting of titanium (Ti) and tungsten (W), while said substrate is disposed in a processing chamber, to form a nucleation layer (claim 16);

removing from said processing chamber said first reactive gas before exposing said substrate to said second reactive gas (5, 38+); and

forming said layer adjacent to said nucleation layer by chemical vapor deposition while said substrate is disposed in said processing chamber by concurrently exposing said nucleation layer to said second reactive gas and a reducing agent (4, 17+).

Regarding claim 11, Kang teaches the reducing agent to be silane (4, 17+).

With respect to claim 12, Kang teaches the use of W ( 4, 41+).

As to claim 13, Kang teaches the final step of the ALD process to be a purge to remove any byproducts (5, 30-56).

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

*(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.*

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 3, 5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700, as applied to claim 1 above.

Regarding claim 3, while Kang fails to teach the bulk deposition layer is deposited employing physical vapor deposition, it would have been obvious to one of ordinary skill in the art to replace CVD with PVD because they are both conventionally accepted methods used to deposit refractory metal nucleation layers.

the examiner takes "official notice" since the claimed subject matter is notoriously well-known in the art (MPEP 2144.03). The formation of a layer by reducing a refractory metal containing gas with silane is a standard, notoriously well-known method of depositing a metal layer.

As to claim 5, while Kang does teach forming a nucleation layer further includes purging said processing chamber of said first reactive gas by using a degassing chamber said processing chamber clear of all gases disposed therein before introducing said second reactive gas (6, 13+), Kang fails to teach using a pump to do this.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a pump in the degassing chamber of Kang because pumps are conventional devices used to purge chambers. The use of conventional materials to perform there known functions in a conventional process is obvious (MPEP 2144.07).

In re claim 6, while Kang does teach forming the refractory metal nucleation layer further includes purging said processing chamber of said first reactive gas by introducing a purge gas and subsequently degassing said processing chamber clear of all gases disposed therein before exposing said substrate to said second reactive gas Kang fails to teach using a pump to do this.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a pump in the degassing chamber of Kang because pumps are conventional devices used to purge chambers. The use of conventional materials to perform their known functions in a conventional process is obvious (MPEP 2144.07).

Claims 7-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700, as applied to claim 1 above, and further in view of Kang et al., U.S. Patent 6,287,965.

Kang '700 fails to teach the use of boron-containing compound such as diborane to form the nucleation layer.

The Examiner points out that the comprising language of the present claims do not rule out the inclusion of a 3<sup>rd</sup> reactive gas to form a WBN layer.

Kang '965 teaches forming an ALD WBN layer followed by a W lower electrode layer (8, 1+). While not specifically stating that the B is supplied by diborane or any other B compound, the examples given relate to the formation of a TiAlN layer wherein all the components are supplied as compounds (8, 27+). One of ordinary skill in the art could then easily surmise that a B-compound would be used to supply the boron to the layer.

The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution. Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin 125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

As to claim 9, both Kang references teach the use of Ar or N<sub>2</sub> purge gases ( '700:5, 46+ & '965: 8, 55+) between chemisorption of each monolayer (see claims of both).

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700, as applied to claim 10 above.

While Kang fails to specify the nucleation layer thickness, it would have been obvious to one ordinary skill in the art at the time of the invention to optimize the nucleation layer thickness (MPEP 2144.05(b)).

### ***Double Patenting***

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-14 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-60 of U.S. Patent No. 6,551,929. Although the conflicting claims are not identical, they are not patentably distinct from each other because they both require serially exposing a substrate to first



and second reactive gases to form a refractory metal nucleation layer, and then forming a bulk deposition layer using vapor deposition to bulk deposit a metal contained in one of said first and second reactive gases.

### ***Conclusion***

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Hsu et al., U.S. Patent 6,194,310, teaches forming an ALCVD metal nitride layer with varying N concentration followed by a CVD metal layer.

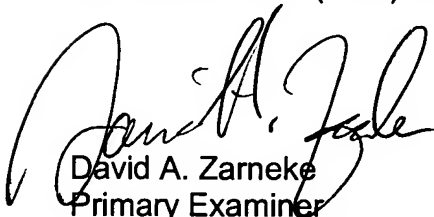
Kang et al., U.S. Patent 6,197,683, teaches forming an ALCVD metal nitride, such as WN, barrier layer followed by a W layer formed by typical methods.

Sneh, U.S. Patent 6,200,893, teaches forming an ALD WN layer followed by an ALD W layer. Since ALD is a form of CVD, this would read upon some of the claims.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David A. Zarneke whose telephone number is (571)-272-1937. The examiner can normally be reached on M-F 7:30 AM-6 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Tokar can be reached on (571)-272-1812. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



David A. Zarneke  
Primary Examiner  
September 23, 2004